

Amendments to the Claims:

This listing of claims will replace all prior versions and listings of claims in the application:

Listing of Claims:

1 Claim 1 (currently amended): A method for calibrating  
2 parameters of sensor elements in a sensor array, comprising  
3 the steps of:

4 receiving ~~an output signal~~ signals of at least two  
5 sensor elements ~~signal~~ in reaction to an input signal from a  
6 signal source;

7 estimating a cross-correlation between the output  
8 signals of at least two of said sensor elements;

9 optimising a difference between the estimated  
10 cross-correlation and a cross-correlation model; and

11 ~~thereby~~ estimating said parameters from the optimised  
12 difference;

13 wherein ~~a~~ the cross-correlation model is ~~used as~~  
14 represented by the following mathematical equation:

$$R = G B G^H + D$$

15  
16 in which ~~equation~~:

17  $R$  represents a cross-correlation matrix,

18  $G$  represent a gain matrix comprising gain parameters,

19  $G^H$  represents ~~the~~ an Hermitian conjugate of the gain matrix,

20  $D$  represents a ((block) diagonal) noise matrix comprising  
21 noise parameters and

22  $B$  represents a matrix comprising information about the  
23 signal source.

1 Claim 2 (original): A method as claimed in claim 1, wherein  
2 said difference is a least square difference.

1 Claim 3 (previously presented): A method as claimed in  
2 claim 1, wherein the cross-correlation is obtained by  
3 determining a time-averaged covariance matrix from the  
4 output signals.

1 Claim 4 (previously presented): A method as claimed in  
2 claim 1, wherein the sensor array is a single polarization  
3 or non-polarized sensor array.

1 Claim 5 (previously presented): A method as claimed in  
2 claim 1, wherein the sensor elements are dual polarization  
3 sensor elements for receiving a dual polarised signal.

1 Claim 6 (previously presented): A method as claimed in  
2 claim 1, wherein said method is performed for output signals  
3 of the sensor elements generated in reaction to input  
4 signals from at least three signal sources with different  
5 polarizations.

1 Claim 7 (original): A method as claimed in claim 4, wherein  
2 said optimising comprises:  
3 minimising a difference between a weighted logarithm of the  
4 estimated cross-correlation and a weighted logarithm of the  
5 cross-correlation and  
6 estimating the gain of at least one of the sensor elements  
7 from said difference.

1 Claim 8 (original): A method as claimed in claim 7, wherein  
2 the logarithm is weighted by a weighting matrix with matrix  
3 values relating to said gain parameters.

1 Claim 9 (previously presented): A method as claimed in  
2 claim 7, wherein said optimising and said estimating gain  
3 parameters are performed at least a first time and a second  
4 time, wherein in the first time an uniform weight is used  
5 for all output signals and in the second time the weight is  
6 used in dependence on the gain estimated in the first time  
7 for the respective output signals.

1 Claim 10 (previously presented): A method as claimed in  
2 claim 7, wherein said optimising comprises an operation as  
3 represented by the mathematical equation:  
4

5  $\{\mathbf{g}_{\text{est}}\} = \text{argmin}_{\mathbf{g}, \mathbf{k}} (\| \mathbf{W} \mathbf{J} \text{vec}(\ln(\mathbf{R}_{\text{est}}) - \ln(\mathbf{g} \mathbf{g}^H) + 2\pi \mathbf{k} i) \|_F)^2,$

6 in which equation:

7  $\mathbf{g}_{\text{est}}$  represents the parameter to be estimated;

8  $\mathbf{g}$  represents a variable;

9  $\mathbf{g}^H$  represents the Hermitian conjugate of the variable;

10  $\mathbf{J}$  represent a selection matrix which puts zeros on the main  
11 diagonal;

12  $\mathbf{k}$  represents a phase unwrapping vector containing integer  
13 values;

14  $\mathbf{W}$  represents a weighting matrix; and

15  $\mathbf{R}_{\text{est}}$  represents the estimated cross-correlation.

1 Claim 11 (previously presented): A method as claimed in  
2 claim 1, wherein the signal source is a satellite in orbit  
3 around a celestial body.

1 Claim 12 (previously presented): A method as claimed in  
2 claim 1, wherein the signal source is a pulsar.

1 Claim 13 (previously presented): A method as claimed in  
2 claim 1, wherein the output signals have a low signal to  
3 noise ratio.

1 Claim 14 (previously presented): A method as claimed in  
2 claim 1, wherein the sensor elements are antennas in a  
3 phased array antenna.

1 Claim 15 (previously presented): A method as claimed in  
2 claim 1, wherein the sensor elements are electro-magnetic  
3 sensors elements.

1 Claim 16 (previously presented): A method as claimed in  
2 claim 1, wherein the sensor elements are acoustical sensor  
3 elements.

1 Claim 17 (currently amended): A calibration system for  
2 calibrating parameters of sensor elements in a sensor array,  
3 the system comprising:  
4       at least two inputs, each connectable to an output of  
5 an a sensor element in a sensor array;  
6       a correlation estimator device for estimating a  
7 correlation between ~~the~~ output signals of at least two of  
8 said sensor elements;

9 an optimiser device for optimising a difference between  
10 the estimated cross-correlation and a cross-correlation  
11 model and ~~thereby~~ estimating said parameters from the  
12 optimised difference; and

13 a memory device containing the cross-correlation model,  
14 ~~which the~~ model is being represented by the following  
15 mathematical equation:

$$R = G B G^H + D$$

16 in which ~~equation~~:

17  $R$  represents a cross-correlation matrix,

18  $G$  represent a gain matrix comprising gain parameters,

19  $G^H$  represents ~~the an~~ Hermitian conjugate of the gain matrix,

20  $D$  represents a noise matrix comprising noise parameters and

21  $B$  represents a matrix comprising information about the

22 signal source ~~and~~.

1 Claim 18 (previously presented): A calibration system as  
2 claimed in claim 17, wherein the sensor array is a dual  
3 polarised sensor array.

1 Claim 19 (original): A calibration system as claimed in  
2 claim 17, wherein the sensor array is a single polarization  
3 or non-polarized sensor array.

Claim 20-22 (cancelled).

1 Claim 23 (new): An array signal processing system having  
2 sensor elements and a calibration system for calibrating the  
3 sensor elements, the calibration system comprising:

4 a device for receiving output signals of at least two  
5 sensor elements in reaction to an input signal from a signal  
6 source;

7 a correlation estimator device for estimating a  
8 cross-correlation between the output signals of at least two  
9 of said sensor elements;

10 an optimiser device for optimising a difference between  
11 the estimated cross-correlation and a cross-correlation  
12 model; and

13 an estimator device for estimating said parameters from  
14 the optimised difference;

15 wherein the cross-correlation model is represented by  
16 the following mathematical equation:

$$R = G B G^H + D$$

17 in which:

18  $R$  represents a cross-correlation matrix,

19  $G$  represent a gain matrix comprising gain parameters,

20  $G^H$  represents an Hermitian conjugate of the gain matrix,

21  $D$  represents a ((block) diagonal) noise matrix comprising  
22 noise parameters, and

23  $B$  represents a matrix comprising information about the  
24 signal source.

25  
26 Claim 24 (new): A computer program having computer  
27 executable instructions and stored in a computer readable  
28 medium and which, when the instructions are executed by a  
29 programmable computer, perform the steps of:

30 receiving output signals of at least two sensor  
31 elements in reaction to an input signal from a signal  
32 source;  
33

34           estimating a cross-correlation between the output  
35 signals of at least two of said sensor elements;

36           optimising a difference between the estimated  
37 cross-correlation and a cross-correlation model; and  
38           estimating said parameters from the optimised  
39 difference;

40           wherein the cross-correlation model is used as  
41 represented by the following mathematical equation:

$$42 \qquad R = G B G^H + D$$

43           in which:

44 **R** represents a cross-correlation matrix,

45 **G** represent a gain matrix comprising gain parameters,

46 **G<sup>H</sup>** represents an Hermitian conjugate of the gain matrix,

47 **D** represents a ((block) diagonal) noise matrix comprising  
48 noise parameters and

49 **B** represents a matrix comprising information about the  
50 signal source.

51  
52 Claim 25 (new): A computer readable medium having computer  
53 executable instructions stored therein, said instructions,  
54 when being executed by a computer, perform the steps of:

55           receiving output signals of at least two sensor  
56 elements in reaction to an input signal from a signal  
57 source;

58           estimating a cross-correlation between the output  
59 signals of at least two of said sensor elements;

60           optimising a difference between the estimated  
61 cross-correlation and a cross-correlation model; and

62           estimating said parameters from the optimised  
63 difference;

64            wherein the cross-correlation model is used as  
65        represented by the following mathematical equation:

$$66 \qquad \qquad \qquad R = G B G^H + D$$

67        in which:

68        **R** represents a cross-correlation matrix,

69        **G** represent a gain matrix comprising gain parameters,

70        **G<sup>H</sup>** represents an Hermitian conjugate of the gain matrix,

71        **D** represents a ((block) diagonal) noise matrix comprising  
72        noise parameters and

73        **B** represents a matrix comprising information about the  
74        signal source.